USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

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Abstract: With the rapid growth of poultry and swine production that is occurring in karst regions of the U.S., understanding hydrogeological and biogeochemical processes controlling transport and processing of nutrients in karst watersheds is critical to the design of effective nutrient management and agriculture practices. Agricultural trends have resulted in the transport of excess levels of the nitrogen (N) to surface and ground waters and knowledge regarding sources and biogeochemical processes controlling N transport in karst systems lags far behind that of other surface- and ground-water systems. The role of soils over karst and the conduit component of karst flow are relatively well understood; however, soil processes often represent a small fraction of the N processing due to the poorly developed soils typical of karst and very little processing is known to occur in karst conduits. Lateral, diffuse flow occurring at permeability contrasts, defined as the interflow zone, represents a potentially important but poorly understood flow path with respect to transport and biogeochemical processing. Key information needed for understanding interflow processes will be accrued for the proposed study through delineation of flow paths through application of tracer and flow monitoring techniques and assessment of nitrate

transformation using isotopic analyses. Hence, our study objectives are to show the importance of the interflow zone as a site for the biogeochemical processes controlling NO_3^- transport and to identify the role of specific hydrological zones in processing NO_3^-.

Although soil pore-water concentrations of DOC and NO_3^- are often high due to manure application, analyses at SEW demonstrate very low DOC (~0.4 mg l^{-1}) and NO_3^- (~1 mg l^{-1}) base-flow concentrations at seeps, which represent the end result of processing within the interflow zone. Additional preliminary study results suggest removal of NO_3^- occurs within the interflow zone and ranges between 4 and 30% (depending upon flow path). The extent of this removal may be related to the relative bioavailability of dissolved organic carbon (DOC). The proposed study will obtain more direct measures of the contribution of the interflow zone to the water budget by conducting tracer tests and monitoring of epikarst flow, and characterization of NO_3^- processing using the newly developed denitrifier technique for stable isotopes of N and O in NO_3^-.

The soil and interflow zones of karst watersheds are vulnerable to agricultural practices. The proposed research will demonstrate the role of specific surface to subsurface zones in biogeochemical cycling of N and the connectivity of these zones to downstream ecosystems. These results will provide a means to understand the impact that hydrologic alteration of these zones can have on delivery of nitrate to the subsurface, and provide a means to devise effective nutrient management and agricultural practices. With these results, we will be poised to test how agricultural practices in karst watersheds impact the integrity of the interflow zone and determine how processes occurring may be capitalized upon for nutrient management. A specific example is the practice of rotational grazing which improves grazing as well as diffuse/focused flow recharge ratios.
